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Labor Market Institutions and Unemployment Dynamics in Transition Economies

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The paper proposes and solves a matching model of job reallocation between the public and the private sector, and it shows that cross-country differences in labor market institutions are broadly consistent with the dynamics of unemployment and real wages in transition economies. Two main results arise from the analysis. First, higher unemployment benefits speed up job destruction in the state sector and private job creation at the early stages of the transition, but they increase unemployment in the long run. Second, higher minimum wages can theoretically speed up the reallocation process without affecting the long run equilibrium. [JEL E24, J63]

SINCE THE EARLY 1990s, a growing body of empirical and theoretical research has shown that the collapse of a centrally planned economy is accompanied by dramatic changes in the labor market.[1] Overall, it is now clear that the reallocation of jobs between a declining public sector and an emerging private sector is associated with a rise in unemployment and a fall

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[1] See, for example, World Bank (1996) and Aghion and Blanchard (1994).

in real wages.[2] Nevertheless, cross-country differences in labor market dynamics remain remarkable. On the one hand, economies in Central and Eastern Europe (CEE), with the exception of the Czech Republic, have experienced dramatic increases in unemployment and substantial declines in real wages. On the other hand, economies in the Commonwealth of Independent States (CIS) have experienced moderate increases in unemployment and dramatic declines in real wages. Not surprisingly, differences in labor market institutions are also notable. CEE economies have generous unemployment insurance systems and high minimum wages, whereas CIS economies, like Russia and Ukraine, have low unemployment benefits and negligible minimum wages. This paper proposes and solves a matching model of job reallocation between the public and the private sector, and it shows that cross-country differences in labor market institutions are broadly consistent with cross-country differences in the dynamics of unemployment and real wages.

Blanchard and Kremer (1997) have recently shown that the breakdown of a centrally planned economy leads to disorganization, with large output decline and massive job destruction. In this paper we argue that labor market institutions are important determinants of the collapse of the state sector and the reallocation of jobs to the private sector. Obviously, institutions that make unemployment more attractive are likely to speed up job destruction in the public sector. In this respect, transition economies with generous unemployment benefits are prone to marked increases in unemployment. Similarly, high minimum wages are likely to induce large employer-initiated job destruction. Conversely, transition economies with no minimum wages and low unemployment benefits should experience massive cuts in real wages, with little increase in job destruction. Thus, cross-country differences in labor market institutions are consistent with cross-country differences in unemployment dynamics. However, labor market institutions also affect private job creation, the speed of job reallocation, and the long-run level of unemployment. We show that unemployment benefits may speed up the transition, but they increase steady-state unemployment. High minimum wages can speed up the reallocation process without affecting private job creation.

In most of the existing literature, job destruction in the public sector is assumed to be exogenous and independent of labor market institutions. While this assumption might be acceptable for analyzing the interactions between private sector development and unemployment, it does not allow for examining the interactions between job destruction in the state sector and unemployment dynamics at the early stages of the transition. We build on two different streams of literature. First, we borrow from the recent lit-

[2] See, in particular, Commander and Tolstopiatenko (1996).

erature on labor markets in transition economies.[3] Second, we use the most recent developments in the matching literature and we analyze the impact of labor market institutions on job creation and destruction.[4] Borrowing from the transition literature, we consider a world in which state sector firms shed labor and private job creation takes time to arise. Borrowing from the most recent matching literature, we focus on the determinants and the dynamics of job destruction and job creation. From the labor market standpoint, the transition is a reallocation process between low productivity jobs in the state sector and high productivity jobs in the private sector. Furthermore, we model disorganization as a sequence of adverse productivity shocks that reduce the present discounted value of state sector jobs. We show that job-worker pairs select a reservation productivity level below which the job is immediately destroyed. Since wages and productivity are intrinsically linked, negative shocks are conducive to lower wages, and, in equilibrium, a higher reservation productivity implies a higher average wage. Finally, as the reallocation of jobs from the state to the private sector is completed, the economy converges to a traditional matching model, in the spirit of Pissarides (1990).

Since the reservation productivity is endogenously determined, we can use the model to examine how the generosity of the unemployment insurance system and the level of the minimum wage affect job destruction in the state sector, and the reallocation of jobs into the private sector. Higher unemployment benefits reduce the present discounted value of state sector jobs, and they increase the reservation productivity. This, in turn, implies higher job destruction and higher unemployment. Furthermore, higher unemployment benefits, through their effect on the reservation productivity, reduce the fall in real wage. Unemployment benefits also affect aggregate job creation, which depends on aggregate unemployment and on the vacancy posting in the private sector. On the one hand, higher benefits increase the workers' outside option, reduce the presented discounted value of a job-worker match, and reduce firms' incentive to post new vacancies. This reduces job creation. On the other hand, higher benefits speed up job destruction in the state sector, and increase the number of people available for work. This increases job creation. Thus, during the transition, the relationship between job creation and unemployment benefits is ambiguous. Nevertheless, several simulations suggest that higher benefits speed up the reallocation process at the beginning of transition. Eventually, as the tran-

[3] See Aghion and Blanchard (1994), Atkeson and Kehoe (1996), Commander and Tolstopiatenko (1996), and Brixiova and Kiyotaki (1997).

[4] See Mortensen and Pissarides (1994) for a model of job creation and destruction, and Mortensen and Millard (1996) and Garibaldi (1998) for links between job

sition process is completed, higher benefits imply lower job creation and higher equilibrium unemployment.

The effects of minimum wages on job reallocation work in the following way. Given a sequence of adverse productivity shocks, the minimum wage increases job destruction in the state sector. A binding minimum wage increases the wage paid to state sector's employees, and it reduces the employers' present discounted value of a state sector job. Thus, employer-initiated job destruction rises, and more people become available for work. Furthermore, if the productivity in the private sector is sufficiently high, wages in the private sector may be above the minimum wage. Thus, the minimum wage may not affect the vacancy posting behavior in the private sector, and it can increase aggregate job creation through its effect on unemployment at the outset of the transition, without causing any increase in steady state unemployment.

I. A Brief Look at the Empirical Evidence

The dynamics of output and unemployment in CEE and CIS economies have been widely documented in the existing literature. While we refer to the extensive work of the OECD and the World Bank for the details on the cross-country variations, in what follows we just review the main characteristics and findings of the empirical literature. With the notable exception of the Czech Republic (Boeri and Burda, 1996), the transition in CEE economies is characterized by a dramatic rise in the unemployment rate. Average unemployment, almost nonexistent at the beginning of the 1990s, has reached the double-digit level in most CEE economies (Table 1). Surprisingly, similar patterns do not hold in the CIS, where officially reported unemployment data show an average unemployment rate of only 4 percent, despite a cumulative output fall in GDP of approximately 50 percent. Table 1 reports unemployment and output dynamics for six CEE economies and two of the largest CIS countries, Russia and Ukraine.[5]

One possible way to reconcile the difference in unemployment dynamics is to question the quality of the unemployment statistics in CIS countries. Several authors, and Standing (1997) in particular, have pointed out the problems with registered unemployment data in CIS countries, and especially in Russia. Standing (1997) points out that official unemployment in Russia is likely to be underestimated because old workers tend to

[5] The selection of countries in Table 1 was driven by the availability of comparable information on labor market institution in International Labour Office (1996). Official unemployment data in other CIS countries show similar results, but it is difficult to find consistent time series on ILO unemployment estimates.

Table 1. *Output and Unemployment Over the Transition*

Country	1989	1990	1991	1992	1993	1994	1995	1996
Bulgaria								
Output	100.0	90.9	80.3	74.4	72.6	73.9	75.8	72.8
Unemployment rate	...	1.5	6.7	13.2	15.7	14.1	11.0	...
Czech Republic								
Output	100.0	99.6	85.5	80.0	79.0	81.0	85.0	89.6
Unemployment rate	...	0.3	2.6	3.1	3	3.3	2.9	...
Hungary								
Output	100.0	96.5	85.3	82.2	81.9	84.2	85.6	86.8
Unemployment rate	0.4	0.8	4.1	10.3	12.9	11.3	10.6	11.1
Poland								
Output	100.0	88.4	82.2	84.4	87.6	92.1	98.6	103.5
Unemployment rate	...	3.4	9.7	13.6	14.9	16.5	15.3	14.4
Romania								
Output	100.0	94.4	82.2	75.0	76.0	78.9	84.4	88.1
Unemployment rate	...	...	3.0	8.4	10.4	10.9	10.4	9.0
Slovakia								
Output	100.0	97.5	83.2	77.8	74.7	78.2	84	88.7
Unemployment rate	...	0.6	6.6	11.4	2.7	14.4	13.9	12.7
Russia								
Output	...	100.0	87.0	74.4	67.9	59.4	56.9	55.3
Unemployment rate[a]	...	...	0.1	0.8	1.0	1.7	2.8	3.6
Unemployment rate[b]	...	...	...	...	5.6	7.5	8.9	9.6
Ukraine								
Output	...	100.0	91.0	82.0	70.4	54.3	47.9	44.5
Unemployment rate[a]	...	0.1	0.3	0.4	0.4	0.6	...	...
Unemployment rate[b]	...	...	...	...	2.4	4.7	...	...

Sources: IMF; European Commission.
[a] Official unemployment.
[b] Unemployment according to ILO definition.

be counted as pensioners even if they are actively searching for jobs, and because the temporarily laid-off are still counted as employed. A first way of dealing with the issue is to consider alternative unemployment statistics, such as the unemployment rate measured by Labor Force Surveys (LFS) that apply international definitions of unemployment. International Labour Office (ILO) measures of unemployment in Russia show that the unemployment rate exceeded 9 percent in 1996. For Ukraine, an LFS was first conducted in 1994 and shows that unemployment, albeit much higher than the officially reported data, is still very low with respect to CEE standards.

Furthermore, once the larger output fall in CIS economies is properly taken into account, Commander and Tolstopiatenko (1996) show that unemployment responded more to the output fall in CEE than in Russia. In CEE economies, output fell by some 20–30 percent and unemployment sharply rose to the double-digit level. Considering an average output fall in the CIS of more than 50 percent, it is clear that the response in the unemployment level in CIS countries was much smaller than in CEE.[6] Another possible explanation of the smaller response of unemployment to the output fall would be a dramatic change in labor force participation in CIS countries. However, labor force participation fell marginally across the entire region, and there does not seem to be a substantial difference between the CIS and CEE.

The dynamics of real wages, measured as the difference between increases in average wages and the increase in the average consumer price index, is another piece of the dramatic difference in labor market dynamics between CEE and CIS countries. Table 2 reports real wage indices for the same countries reported in Table 1. Overall, there is a substantial fall in real wages across the entire region. However, the magnitude of the fall varies between CEE and CIS countries. If real wages in CEE were equal to 100 in 1989, in the Czech Republic, Hungary, Poland, and the Slovak Republic, they fell by some 30 percent, while they fell by about 50 percent in Bulgaria and Romania. Similar data constructed for Russia and Ukraine show that the cumulative fall in real wages was higher than 60 percent in Ukraine, reaching almost 70 percent in Russia. The problem with official wage data in CIS countries is that they disregard wage arrears, and it is quite likely that the actual fall in real wages was much higher than what is reported in official data. As the recent work by Standing shows, in the Russian Federation about 70 percent of workers report that their firms owe them wage arrears. Besides the nonpayment of wages, workers report that they were put on minimal salary, well below the contractual wage rate and in some cases below the minimum subsistence income. In CEE countries, the problem with wage arrears has been fairly limited so far.

Table 3 reports time-series data on the dynamics of private sector employment for the eight countries in our sample. International comparison of private sector shares is very difficult, since the definition of public employment varies substantially across countries, especially in partially privatized firms. With the exception of Poland and Hungary, countries started the transition with very low employment levels in the private sector,

[6] Our paper does not try to rationalize cross-sectional differences in the output profile. Blanchard and Kremer (1997) argue that CIS countries were characterized by a much more complex production system than CEE economies. In their model of disorganization, the more complex a production process is, the larger is the induced fall in output. Since the structure of production was more complex in the CIS than in the CEE, it is not surprising to observe a larger output fall in CIS economies.

Table 2. *Real Wage Indices Over the Transition*

Country	1989	1990	1991	1992	1993	1994	1995	1996
Bulgaria	100.0	106.2	61.3	72.7	73.5	58.6	48.6	...
Czech Republic	100.0	94.5	69.7	76.8	79.6	84.7	90.7	...
Hungary	100.0	99.8	96.1	97.7	97.3	102.2	96.1	...
Poland	100.0	72.6	72.7	70.6	68.5	68.9	69.2	...
Romania	100.0	104.5	82.9	72.2	55.4	44.4	51.2	...
Slovakia	100.0	94.6	67.5	73.8	71.0	73.2	75.2	...
Russia	...	...	100.0	42	41.5	37.9	29.2	32.4
Ukraine	...	...	100.0	73	37.1	32.8	36.8	38.2

Sources: IMF; and European Commission (1995).

Table 3. *Private Sector Share in Employment in Transition Economies*
(In percent)

Country	1989	1990	1991	1992	1993	1994	1995
Bulgaria	5.5	5.9	10.1	17.7	28.3	34.7	...
Czech Republic	1.3	6.9	18.8	31.1	47.1	...	...
Hungary	...	...	...	...	...	59.4	...
Poland	45.7	45.8	51.1	57.0	57.6	59.8	...
Romania	5.9	9.2	33.6	41.0	43.8	51.4	...
Slovakia	1.0	5.0	12.8	18.4	22.2	31.9	...
Russia	...	...	...	...	28.0	33.0	34.4
Ukraine	...	...	...	...	...	8.0	16.0

Sources: EBRD (1995); and International Monetary Fund.

and experienced a sharp increase in private sector development. Overall, there is no clear relationship between unemployment dynamics and private sector development. On the one hand, countries with a large increase in unemployment, like Hungary and Poland, have the largest private sector shares, while the CIS countries, with the lowest increase in unemployment, have the lowest share of private sector employment and the lowest increase in unemployment. On the other hand, countries like Bulgaria and the Slovak Republic have large increases in unemployment, but comparatively low shares of private sector employment. Furthermore, if we consider that Russia and Ukraine started the transition only in 1992, the relationship between unemployment and private sector development becomes very

Table 4. *Minimum Wage Over the Transition*
(Minimum wage as a percentage of average wage)

Country	1989	1990	1991	1992	1993	1994	1995
Bulgaria	...	43.7	53.3	35.0	38.3	36.8	34.7
Czech Republic	...	...	52.3	47.1	37.4	31.9	27.5
Hungary	34.6	37.3	37.4	35.9	32.8	31.2	...
Poland	18.0	21.0	34.0	43.0	41.0	43.0	43.0
Romania	66.4	57.2	55.5	42.3	39.2	31.4	26.2
Slovakia	...	...	52.3	48.5	41.0	38.9	37.1
Russia	27.0	24.0	14.0	9.0	9.0	7.0	10.0
Ukraine	...	32.3	53.0	20.3	7.6	3.0	0.8

Source: ILO (1996).

weak. Finally, it is very difficult to compare the dynamics of private sector development between CEE and CIS economies, since only few observations are available for Russia and Ukraine.

Labor Market Institutions

This paper argues that cross-country differences in labor market dynamics are linked to cross-country differences in labor market institutions. Table 4 reports time-series data on the minimum wages, measured as a percentage of the average wage. Two facts are worth noting. First, as Standing and Vaughan-Whitehead (1995) recognize, there is an overall tendency for the minimum wage to fall. Second, since 1993 the minimum wage in Russia and Ukraine has been exceptionally low. In Russia and Ukraine, the minimum wage is less than 10 percent of the average wage, whereas it averages about 35 percent in other CEE economies. Overall, it is reasonable to assume that there is no minimum wage in Russia and Ukraine. The difference in minimum wages between CEE and CIS countries is remarkable, as is the difference in the dynamics of unemployment between the two regions. CEE economies have high minimum wages and experienced sharp increases in unemployment and moderate falls in real wages, whereas Russia and Ukraine have experienced moderate increases in unemployment, dramatic cuts in real wages, and very low minimum wages. As we show in more detail in Section V, our theory is consistent with these cross-country observations.

As was also pointed out by Commander and Tolstopiatenko (1996), the generosity of the unemployment insurance system is an important determinant of labor market dynamics. In CEE economies there has been some

Table 5. *Generosity of the Unemployment Insurance System in 1994*

Country	Minimum wage over average wage[a]	Average benefit level[b]	Average benefit duration[c]	Generosity index[d]
Bulgaria	36.8	42.3	8	338.6
Czech Republic	31.2	55.0	6	330.0
Hungary	43.0	64.5	24	1,548.0
Poland	31.4	36.0	18	648.0
Romania	31.4	55.0	9	495.0
Slovakia	38.9	55.0	6	330.0
Russia	7.0	13.0	18	234.0
Ukraine	3.0	14.0	8	112.

Sources: ILO (1996); and authors' calculations.
[a]Minimum wage in 1994; see Table 4.
[b]Average level of benefit in 1994. Average level of benefit calculated as follows: Bulgaria, 115 percent of minimum wage; Czech Republic, 55 percent of average wage; Hungary, 150 percent of minimum wage; Poland, 36 percent of minimum wage; Romania, 55 percent of the average wage; Slovakia, 55 percent of average wage; Russia, 55 percent of wages in the previous year; Ukraine, 60 percent of wages in previous job.
[c]Average duration of benefit in months.
[d]Average level of benefit times average duration in months.

fall in the level of the unemployment benefits, but the replacement ratio is still on the order of 40–50 percent. Table 5 reports 1994 data on average unemployment benefits and on the unemployment insurance system for the same countries for which we have data on the minimum wage. If we take the Russian Federation and Ukraine as representative countries for the CIS, the differences highlighted in Table 5 are remarkable. In the Russian Federation, unemployment benefits as a percentage of the average wage fell below 15 percent, while in CEE economies they remain well above 40 percent.[7] Data on the average benefit duration suggest that there is no remarkable difference between CEE and CIS economies. The last column of the Table 5 proposes a simple measure of the generosity index and suggests that Ukraine and Russia fell at the very bottom of the proposed scale. In CEE, as Commander and Tolstopiatenko report, unemployed workers are entitled to social assistance after the expiration of the unemployment

[7]The level of the average benefit in Table 5 is calculated on the basis of the existing legislation, as described by ILO (1996) and summarized in Table 5. While CEE economies link time *t* benefits to the average wage (or the minimum wage) at time *t*, Russia and Ukraine calculate the benefits in a different way. Russia links the benefit to the wage in the previous year and this practice, in periods of high inflation, substantially reduces the replacement ratio. Ukraine links the benefit to the salary of the previous job, providing no automatic indexation for periods of high inflation. Hence the very low coverage with respect to the average wage in 1994.

Table 6. *Firing Cost in Selected Transition Economies*

	Severance payments	Prior notice
Bulgaria	2 months' gross pay	1 month if bankrupt or mass layoffs
Czech Republic	2 months' gross pay	paid through severance payments
Poland	≤ 10 years: 1 month's pay; 10–20 years: 2 months	works council must be consulted
Romania	none	not enforced
Slovakia[a]	2 months' gross pay	paid through severance payments
Russia	2 months' wage; 3 months' wage if worker does not find a job	...
Ukraine	none	3 months

Sources: Burda (1993); and International Monetary Fund (1996a and 1996b).
[a]Identical to Czech Republic for 1993.

insurance. In Russia, by contrast, when the unemployment insurance expires, workers have no further assistance. Comparing Table 1 and Table 5, there also appears to be a cross-country relationship between the generosity index and labor market dynamics. CEE economies have a much more generous unemployment system than CIS economies, and experienced a larger increase in unemployment.

Finally, Table 6 looks at the structure of firing costs. Information on severance payments and prior notice indicates that firing costs are not very high by western European standards (OECD, 1994). Furthermore, from Table 6, there is no significant difference between the structure of firing costs in CEE countries and in Russia and Ukraine. Thus, cross-country differences in unemployment dynamics do not seem to be linked to different degrees of job security provisions.

II. The Existing Literature

A comprehensive survey of the literature on labor markets in transition economies is beyond the scope of this paper.[8] Most of the papers in the literature are descriptive in nature, and they offer an empirical analysis of labor market dynamics in specific transition economies.[9] A smaller set of

[8] World Bank (1996) provides a comprehensive introduction.
[9] See Commander and Coricelli (1995).

papers model the job reallocation process between the state and the private sector, and at least three papers focus on the interactions between labor market institutions and unemployment.[10] This section briefly reviews these three papers, highlights their main results, and explains the main contributions of this paper to the literature.

Aghion and Blanchard (1994) solve a model of transition from a low-productivity (state) to a high-productivity (private) sector, and they study the interactions between unemployment, state-sector restructuring, and private sector development. They find that the unemployment level has an ambiguous impact on the speed of transition. As higher unemployment decreases wages in the private sector, it speeds up the rate of private sector formation through an increase in private sector profits. Simultaneously, higher unemployment increases expenditures on unemployment benefits. To the extent that these expenditures are financed by taxes imposed on private firms, they lower profits and job creation in the private sector. Throughout the analysis, Aghion and Blanchard assume that the decision to 1 of the transition, and they show how different levels of unemployment compensation and tax rates imply differences in unemployment dynamics. Similarly to our paper, they find that higher unemployment benefits increase unemployment. However, in contrast to our paper, they find that higher unemployment benefits reduce the closure of the state sector. Furthermore, their model does not try to explain differences in the behavior of real wages.

With respect to the existing literature, our paper has three main innovations. First, we consider the effect of labor market institutions on both job destruction in the state sector and job creation in the private sector, solving a dynamic general equilibrium model. Second, we analyze simultaneously the behavior of unemployment and real wages. Finally, we carefully distinguish between transition effects and long-run effects of different labor market institutions.

III. Description of the Model

In an economy consisting of two sectors with different productivity levels, the transition is akin to a reallocation process from the low-productivity to the high-productivity sector. Our model focuses on the decision to close down state sector jobs, and on the implications of this decision on the dynamics of unemployment and real wages. This section introduces concepts and notation, while Section IV formally describes job creation in the private sector and job destruction in the state sector.

[10]A good set of models of the transition is contained in Commander (1997) and in Blanchard (1997).

Concepts and Notation

We focus on the behavior of the system at the beginning of the transition, when central planning has collapsed but state sector firms are still producing. Throughout the transition, state sector jobs are destroyed and, simultaneously, new job opportunities arise in the private sector. As the share of state sector jobs converges to a predetermined proportion, assumed to be zero for simplicity, the transition process is completed and the system converges to the unique steady-state position.

In the economy there are low-productivity jobs in the state sector and high-productivity jobs in the private sector. State sector jobs are in only one state, filled and producing, and there is no job creation in the state sector. Private sector jobs, however, can be in two different states, filled and producing or vacant. Time is continuous and workers are homogeneous, have the same risk-neutral preferences in consumption, and are endowed with one flow unit of time. The labor force is constant, and it is normalized to one for simplicity. Workers can spend their unit of time working and producing, or being unemployed and searching for jobs. We assume that there is no on-the-job search and worker movements from the state sector to the private sector require workers to experience an unemployment spell. This assumption is analytically convenient but not irrelevant, and we discuss it in more detail in Section VI. Finally, since our focus is on jobs, rather than on firms, we assume that each firm is made up of only one job.

Unlike other models of labor reallocation in transition economies, the model in this paper explicitly allows for heterogeneity in the state sector. We assume that labor productivity in the state sector can take different values, and stochastically jumps across these values. In the spirit of the recent developments in the matching literature, we model the existing risk for state sector jobs as a jump process and a drawing from a specific probability structure. Once an adverse productivity shock hits a state sector job, the value of its labor product will be permanently lower, but the residual value of future streams of production may still be positive. When the present value of the job turns negative, the job is immediately destroyed, the match is dissolved, and the worker switches to unemployment. The idea that the transition is associated with output fall and with the collapse of the state sector has recently been rationalized by Blanchard and Kremer (1997) in a formal model of disorganization.[11] In

[11] Blanchard and Kremer (1997) claim that under central planning, economic relationships were based on specific, one-to-one relationships that opened room for bargaining. However, the coercive power of the central planner warranted an outcome to the bargaining process. During the transition, the coercive power of the central

this paper, the permanently adverse shocks to the state sector are meant to capture the disorganization that follows the breakdown of the central planning.

As the simulations in Section VI will show, our structure of productivity shocks leads to unemployment profiles consistent with a typical transition economy. In particular, Table 1 suggests that the largest unemployment increase is observed a few years after the beginning of the transition. In principle, it would be possible to model the shocks to state sector jobs through a unique initial jump in the productivity of state sector jobs, but it would be difficult to explain why the largest rise in unemployment takes place after the realization of the shock. Conversely, our assumptions are consistent with a delayed rise in unemployment. In our framework, state sector jobs face certain job destruction, but the actual timing of the job-worker separation depends on a specific sequence of productivity shocks and on labor market institutions, and is likely to take place after the initial shock.

The Matching Process

We model private sector development as a costly and time-consuming process.[12] For analytical convenience, we abstract from heterogeneity in the private sector and we assume that the high productivity in the private sector is time invariant. Nevertheless, private sector jobs are subject to catastrophic events that lead to immediate job destruction. In a matching environment, vacancies and unemployed workers search for each other with a view to establish profitable employment relationships. In reality, vacant jobs and unemployed job seekers take time to locate each other, and the information on vacant jobs is not immediately available to the workers. Thus, unemployed workers and vacant jobs coexist in the labor market, and only a fraction of the potential matches take place in a given period. In aggregate models of the labor market, this complex process is described by an *aggregate matching function*.[13] In the rest of the paper we assume that the number of matches that are formed in a time interval can be described by a function $m(u,v)$, where

planner disappears, and the relationships have to be solved by decentralized bargaining between suppliers and buyers. Blanchard and Kremer show that when the bargaining inefficiently breaks down (owing to the incomplete contracts or asymmetric information), output immediately falls.

[12] Brixiova and Kiyotaki (1997) propose a model entirely focused on private sector development in a transition economy.

[13] The matching function is a technological function that describes the trading technology of the labor market, and is often compared to an aggregate production function, which encodes in a simple function the technological characteristic of an aggregate system. For an introduction see Pissarides (1990).

u is the unemployment rate and v is the vacancy rate. Assuming that vacancies and unemployed workers coexist in the market at all times is equivalent to assuming that

$$m(.) < \min[u, v], \tag{1}$$

or that the number of matches m is lower than the smallest between u and v. Furthermore, $m(u, v)$ is increasing and concave in each of its arguments, and is homogeneous of degree one.[14] By virtue of the latter assumption, there are constant returns to matching, and the transition probabilities in the labor market depend only on the relative number of traders. In fact, the probability that a vacant firm meets an unemployed job seeker can be written as

$$\frac{m(u,v)}{v} = m\left(\frac{u}{v},1\right) = q(\theta) \qquad \theta = \frac{v}{u}, \tag{2}$$

where $\theta = v/u$ is the relative number of traders in the market, or a measure of market tightness from the firms' standpoint. Since $m(.)$ is homogeneous of degree one, an increase in market tightness θ reduces the probability that a vacant job meets an unemployed job seeker, and $q'(\theta) < 0$. Proceeding similarly, the probability that an unemployed job seeker meets a vacant firm is

$$\frac{m(u,v)}{u} = m\left(1,\frac{v}{u}\right) = \frac{v}{u} m\left(\frac{u}{v},1\right) = \theta q(\theta), \tag{3}$$

where $\theta q(\theta)$ is the worker's probability of meeting a new vacancy. An increase in market tightness increases the worker's probability of being matched, and $\partial[\theta q(\theta)]/\partial\theta > 0$.

The matching function and the existence of positive search costs generate a pure economic rent to be split between job-worker pairs. In this paper, and similarly to Mortensen and Pissarides (1994), we assume that firms and workers split the surplus from the job in a fixed proportion at all times, and workers enjoy a fraction β of the total surplus. We start the process with most workers in the state sector, and we keep track of the reallocation of jobs and workers into the private sector. Once the state sector disappears, the model behaves like a traditional matching model, in the spirit of the analysis of Pissarides (1990).

[14] The matching function exhibits constant returns to scale in unemployment and vacancies. For transition economies, Burda (1993) and Boeri and Burda (1996) offer empirical estimates of the matching function.

IV. The Model

We present and solve the model in three different blocks. First, we model job creation in the private sector and we solve for the dynamic path of the vacancy unemployment ratio θ, which in our setup turns out to be constant over time. Second, we present the equations describing job destruction in the state sector, and we derive an expression for the productivity level below which the continuation of production is no longer profitable. Finally, given the reservation productivity and the vacancy-unemployment ratio, we specify aggregate dynamics. We begin the transition with most of the jobs in the state sector. As the productivity in the state sector falls below the reservation level, state sector jobs are destroyed, unemployment increases, and job creation in the private sector goes up. Eventually, when the process of job destruction in the state sector is completed, the system converges to the unique steady-state position. For simplicity, we omit the time subscript in the derivation of the model.

Job Creation in the Private Sector

A job is a production opportunity to the firm, and we describe its value in terms of asset valuation functions. In what follows, V^p and J^p shall indicate, respectively, the present discounted value of a private vacant job and a private filled job. Job creation takes place when a vacancy is matched with an unemployed job seeker. A vacancy is an asset owned by the firm and it yields a negative dividend and two capital gains. The negative dividend is the flow cost γ of posting a vacancy, while the capital gains are the expected value of finding a worker and running a filled job, and the change in the value of a private vacant job over time. More formally, the value of a vacant job reads

$$rV^p = -\gamma + q(\theta)\left(J^p - V^p\right) + \dot{V}^p, \tag{4}$$

where r is the interest rate, $q(\theta)$ is the probability of filling in a vacancy, $(J^p - \dot{V}^p)$ is the capital gain associated with the filling of the job, and $\dot{V}^p$ is the capital gain associated with change in the value of a vacancy over time. As in Pissarides (1990), we assume that there is free entry in the job market and exhaustion of rents. Since there is no cost in creating a vacancy, the free-entry condition implies that the value of a vacant job must be zero. Substituting for $V^p = \dot{V}^p = 0$, equation (4) yields

$$J^p = \frac{\gamma}{q(\theta)}. \tag{5}$$

Equation (5) is the first key equation of the model and shows that the presented discounted value of a job in the private sector is equal to expected search costs. For a given value of J^p, equation (5) uniquely solves for the vacancy unemployment ratio θ. To complete the description of the private sector, we need an expression for J^p, which depends on the constant productivity in the private sector y^p and on the wage paid to the worker w^p.

Since matching is costly and time-consuming, existing job-worker pairs are endowed with local monopoly power and enjoy a pure economic rent. The value of this rent is the *surplus* from the match, and is formally indicated as the sum of the firm's and worker's values of filling a job, net of their outside options. If we indicate with E^p the value to the worker of being employed in the private sector, and with U the present discounted value to the worker of being unemployed, the surplus from the match, W^p, can be formally written as

$$W^p = \left(J^p - V^p\right) + \left(E^p - U\right) = J^p + E^p - U, \tag{6}$$

where the second equality made use of the free-entry condition of equation (5). In this paper we follow the standard assumption in the matching literature that the worker gets a fraction β of the total surplus. The wage in the private sector splits the surplus from the job in the following way:

$$E^p - U = \beta W^p; \qquad J^p = (1-\beta)W^p, \tag{7}$$

where β is the worker's share of the total surplus. Following the simple algebra of Appendix I, the surplus from the job reads

$$\left[r + \lambda + \beta\theta q(\theta)\right]W^p = y^p - b + \dot{W}^p, \tag{8}$$

where λ is the rate at which private sector jobs are destroyed and b is the income of the unemployed people, or the value of the unemployment benefits. Equation (8) is the second key equation of the model and can be interpreted in the following way. A job-worker pair generates a surplus equal to the present discounted value of the net stream of production. Equation (8) also features a capital gain term, which keeps track of the changes in the value of the surplus over time. Finally, the terms in the square bracket of the left-hand side of equation (8) is the factor by which worker-firm pairs discount future profits, and it depends positively on three factors: the pure discounted rate r, the probability of destruction λ, and the probability that a worker is matched to another job. Substituting equation (5) into equation (8), and making use of the splitting rule, (7) yields a differential equation in

θ.[15] The equilibrium value of θ is unique and constant throughout the transition.

Job Destruction in the Public Sector

To capture the disorganization that follows the beginning of the transition, we assume that public sector jobs are subject to adverse productivity shocks, and the value of their labor product is heterogeneous. Adverse shocks hit state sector jobs according to a Poisson process with instantaneous arrival rate equal to δ.

Let y_i^s denote the productivity of a public sector job of type i, where i is a flow of production that can take n different values. In general, $y_i^s > y_j^s$ as long as $i > j$, so that the index i measures productivity in a state sector job. Furthermore, $y^p > y^n$, so that private sector jobs are always more productive than state sector jobs. Conditional on being hit by a shock δ, the productivity of a state sector job, y_i^s changes according to a stochastic matrix $\boldsymbol{P}$, whose general row i reads

$$p_{ij} = 0 \quad for \quad j > i$$
$$p_{ij} = \frac{1}{i} \quad for \quad j \leq i. \tag{9}$$

The stochastic matrix (9) captures the idea that the transition is associated with a fall in productivity of state sector jobs. The first row of (9) implies that a job of productivity i has no chance of improving its productivity to an index $j > i$. Moreover, the second row in equation (9) implies that a job with productivity i faces a uniform probability of moving to a job with productivity j, where j cannot be higher than the current one, that is, $j \leq i$. The transition matrix $\mathbf{P}$ implies that the lowest productivity state is an absorbing state, and state sector jobs would reach this state in finite time.

Let J_i^s be the value of a state job with productivity i. Given the probability matrix described in equation (9), J_i^s solves

[15] Specifically, this differential equation reads

$$\frac{(r+\lambda)\gamma}{(1-\beta)q(\theta)} = y^p - b - \frac{\gamma q'(\theta)}{q(\theta)^2}\dot{\theta} - \frac{\beta\gamma\theta}{1-\beta}.$$

In the steady-state equilibrium, by definition, θ is constant over time, that is, $\dot{\theta} = 0$. It is straightforward to see that θ is also unique and constant along the equilibrium transition path. For a similar model without the state sector, see Pissarides (1990).

$$rJ_i^s = y_i^s - w_i^s + \delta \sum_{k=1}^{i} \frac{1}{i}\left(\max\left[J_k^s, 0\right] - J_i^s\right) + \dot{J}_i^s, \tag{10}$$

where y_i^s is the flow of production in a state sector job with productivity i, and w_i^s is the wage associated with that job. Adverse productivity shocks hit state sector jobs at rate δ, and the term in parentheses reflects the choice faced by state sector jobs. For each productivity value $k<i$ that the firm may reach, the max operator in equation (10) shows that state sector jobs will be kept open as long as their value is still positive. Finally, $\dot{J}_i^s$ is the change in the value of the job over time. However, along the equilibrium path θ is constant and $\dot{J}_s^i = 0$.[16]

Similarly, when adverse productivity shocks hit state sector jobs, public sector employees have the option to leave the job and switch to unemployment. Denoting with E_i^s the asset value of a worker employed in a state sector job with productivity i, the corresponding value function reads

$$rE_i^s = w_i^s + \delta \sum_{k=1}^{i} \frac{1}{i}\left(\max\left[E_k^s, U\right] - E_i^s\right) + \dot{E}_i^s, \tag{11}$$

where the max operator in (11) reflects the option of state sector workers of leaving the job, switching into unemployment, and looking for a job in the private sector.

Since the outside option for a state sector job has zero value, the surplus in a state sector job of productivity i reads

$$W_i^s = J_i^s + E_i^s - U. \tag{12}$$

If the worker gets a fraction β of the surplus, a state firm and a state employee agree on which jobs should be kept open. Since $(E_i^s - U) = \beta W_i^s$ and $J_i^s = (1-\beta)W_i^s$, the maximization in equations (10) and (11) suggests that a worker and the firm will keep running a state sector job as long as the surplus is positive, that is, $W_i^s > 0$. Substituting equations (10) and (11) into equation (12), together with the asset equation for the value of unemployment,[17] the total surplus from a state sector job with productivity i satisfies

[16] This is also true for the time derivative in equations (11) and (13).

[17] As we show in Appendix I, the asset valuation function for an unemployed worker reads

$$rU = b + \theta q(\theta)\left(E^p - U\right),$$

or, making use of the sharing rule (7), $rU = b + \theta q(\theta)\beta W^p$.

$$rW_i^s = y_i^s - b + \delta \sum_{k=1}^{i} \frac{1}{i}\left(\max\left[W_k^s, 0\right] - W_i^s\right) - \theta q(\theta)\beta W^p + \dot{W}_i^s. \quad (13)$$

Since the surplus from the job is an increasing function of the productivity y_i^s, the decision to destroy state sector jobs satisfies the reservation property. Thus, job-worker pairs select a reservation productivity index, i^*, such that a job is kept running as long as the productivity is at least as high as i^*. Formally, the reservation productivity i^* is the lowest productivity index associated with a positive total surplus, and satisfies the following condition:

$$i^*: W_{i^*}^s > 0, \qquad W_{i^*-1}^s \leq 0. \quad (14)$$

The definition of the reservation productivity completes the description of job destruction in the state sector. Making use of the definition of W_{i*}^s, and setting $\dot{W}_{i*}^s = 0$, as is true in equilibrium, the value of the marginal state sector job is

$$W_{i^*}^s = \frac{y_{i^*}^s - rU}{r + \delta \frac{i^* - 1}{i^*}} \geq 0. \quad (15)$$

Equation (15) is the key equation of the state sector and it describes the value of the marginal state sector job, when the value of the output, y_{i*}^S, is just sufficient to cover the permanent income of the unemployed, rU. Intuitively, as soon as the productivity of a state sector job is lower than the permanent income of an unemployed worker, a job should immediately be destroyed.

To close the model, we need to specify the dynamics of unemployment. Since the distribution of state sector jobs continuously changes, we also need to keep track of the distribution of state sector jobs at different productivity levels. The equations describing the transition paths of unemployment and employment in each sector are provided in Appendix II.

V. Labor Market Institutions

The dynamics of aggregate labor market variables (unemployment, employment, and real wages) is driven by the reservation productivity selected in the state sector. Thus, different values of the productivity shocks affect job destruction in the state sector, and the speed of convergence to the steady state. In what follows, we focus on the relationship between labor market dynamics and two labor market institutions: the unemployment benefits and the minimum wage.[18]

Unemployment Benefits

In the stylized model proposed in Section IV, the income flow of the unemployed, b, is correlated with the level of unemployment benefits, an exogenous policy parameter. Thus, a natural policy exercise is to examine how changes in unemployment benefits affect labor market dynamics.

The level of unemployment benefits affects both job creation in the private sector and job destruction in the state sector, and Appendix III shows several comparative static exercises. Job creation at time t is defined as the flow of people who find new jobs in the private sector, and is formally expressed as

$$JC \equiv \theta q(\theta)u, \tag{16}$$

where the job-finding rate $\theta q(\theta)$ is constant over the transition. Aggregate job destruction depends on job destruction in both sectors, and its formal expression is

$$JD = \lambda n^p + \delta \sum_{k=i^*}^{n} \frac{i^* - 1}{k} n_k^s, \tag{17}$$

where n^p is private employment and n_k^s is employment in a state sector job with productivity k. The first expression captures job destruction in the private sector, which depends on the exogenous idiosyncratic shock λ, while the second term captures job destruction from the state sector. The index in the summation in equation (17) reflects the fact that only jobs with idiosyncratic productivity greater than or equal to i^* are active. Intuitively, the higher the reservation productivity i^*, the greater the probability that a shock δ leads to immediate job destruction. At the early stage of the transition, job destruction depends entirely on the second term, since in equation (17) the share of the private sector is very small. Eventually, as the shocks δ are realized, job destruction in the state sector fades away.

There are two effects of unemployment benefits on the private sector. First, a higher unemployment benefit, increasing the value of the outside option to the unemployed, reduces the surplus of a private sector job, thus $(\partial W^p/\partial b) \leq 0$. Second, higher unemployment benefits, through their effects on the private

[18]Garibaldi and Brixiova (1997) also discusses the impact of firing costs on the speed of transition.

surplus, reduce the vacancy unemployment ratio and increase steady-state unemployment, thus $\partial u/\partial b \geq 0$ and $\partial\theta/\partial b \leq 0$. With respect to the public sector, higher benefits reduce the surplus from a job and increase the reservation productivity in the state sector, that is, $(\partial W_{i^*}^s)/(\partial b) \geq 0$. Thus, higher benefits increase the productivity level at which state sector jobs are destroyed. This, in turn, speeds up the destruction of the state sector.

During the transition, the relationship between unemployment benefits and labor market dynamics works as follows. With respect to job destruction, higher unemployment benefits speed up the flow from the state sector into unemployment. For a given sequence of productivity shock, a higher reservation productivity induces faster destruction in state sector jobs and a larger increase in unemployment. With respect to job creation, there are two effects at work. First, higher unemployment benefits reduce market tightness, θ, and they reduce job creation. Second, higher benefits increase the number of people available for work and increase the job creation flow into the private sector. The overall relationship between benefits and job creation depends on which of these two effects dominates.

To analyze the comparative dynamics of different levels of b, we rely on a set of simulations, which are meant to be suggestive, rather than fully realistic. The values of the parameters are given in Table 7, and they are chosen so that the steady-state equilibrium roughly matches the statistics of a representative OECD economy. Table 8 reports the most important simulation statistics that result from the numerical solutions, while Figures 1 and 2 keep track of the dynamics of unemployment and real wages for different levels of unemployment benefits. Table 8 shows that when the replacement ratio, defined as the ratio of unemployment benefit to the average wage, falls from 0.3 to 0.1, steady-state unemployment falls by approximately 1 percentage point. However, as Figure 1 shows, this marginal change in unemployment benefits produces remarkable differences in the dynamics of unemployment. When the benefit ratio is relatively high, unemployment immediately jumps to the double digit-level and converges to the steady-state level with a hump-shaped dynamic. Conversely, when the replacement ratio is relatively low, unemployment does not jump, but rises smoothly and converges monotonically to its steady-state value. Figures 3 and 4 show that the difference in unemployment dynamics is driven by differences in the speed of job destruction and job creation. When benefits are relatively high, jobs in the state sector are destroyed quickly, since the incentive to hold on to low-productivity jobs in the state sector is relatively low. Thus, in Figure 4, the share of jobs in the state sector falls dramatically. At the same time, the large number of people that enter unemployment induces an increase in private sector

Table 7. *Baseline Parameter Values*

Variable	Notation	Value
Matching elasticity	α	0.50
Friction parameter	γ	1.00
Bargaining share	β	0.40
Turnover rate (private)	λ_p	0.09
Interest rate	r	0.04
Productivity (private)	y^p	1.00
Productivity (public)	y_1^s	0.98
Productivity (public)	y_n^s	0.78
Productivity states	$i \ldots n$	20.00
State sector shock rate	δ	0.25
Unemployment benefit	b_{high}	0.30
Unemployment benefit	b_{low}	0.10
Minimum wage (high)	w_{max}	0.81
Minimum wage (low)	w_{min}	0.00

Source: Authors' calculations.

Table 8. *Simulation Statistics*

Simulation	Steady-state unemployment u^*	Private sector wage w^p	Benefit level, replacement ratio in steady state b/w^p	Minimum wage $\bar{w}$
Benefits				
b = 0.30	0.093	0.89	0.34	0.00
b = 0.20	0.087	0.88	0.23	0.00
b = 0.10	0.082	0.87	0.12	0.00
Minimum wage				
b = 0.20	0.087	0.88	0.23	0.00
b = 0.20	0.000	0.88	0.23	0.81

Source: Authors' calculations.

jobs. With relatively high benefits, it takes 20 quarters for the share of private sector to reach the share of public employment. Conversely, with low benefits, the reallocation process is much slower, and the share of jobs in the private sector reaches the share of state sector jobs only after 60 quarters. Numerically, the effects of benefits on job creation are positive, suggesting that the unemploy-

Figure 1. *Transition of Unemployment for Different Benefit Levels*

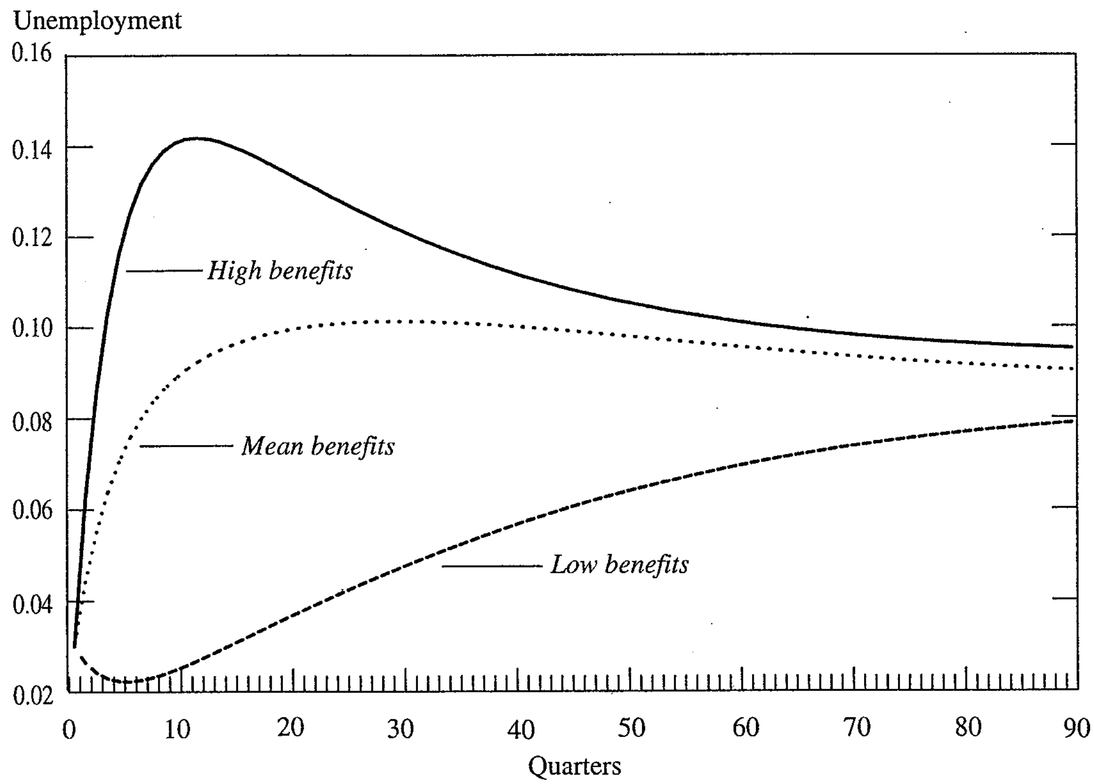


Figure 2. *Transition of Real Wages for Different Benefit Levels*

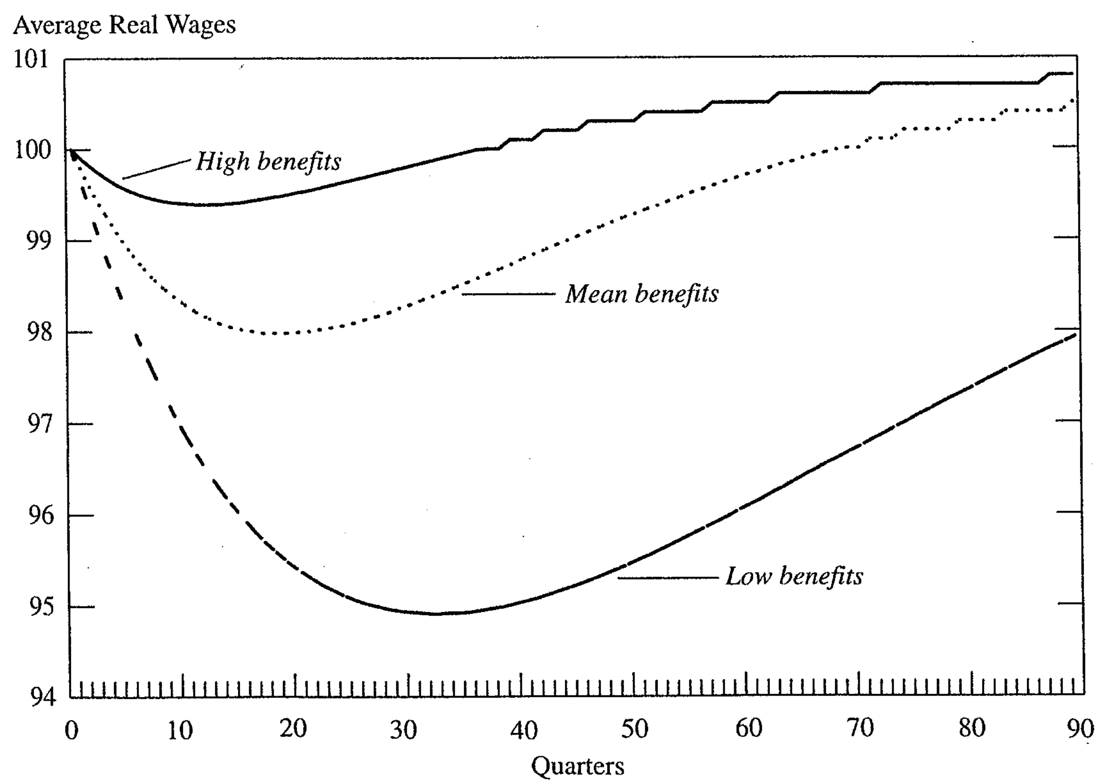


Figure 3. *Private and State Sector Jobs with High Benefits*

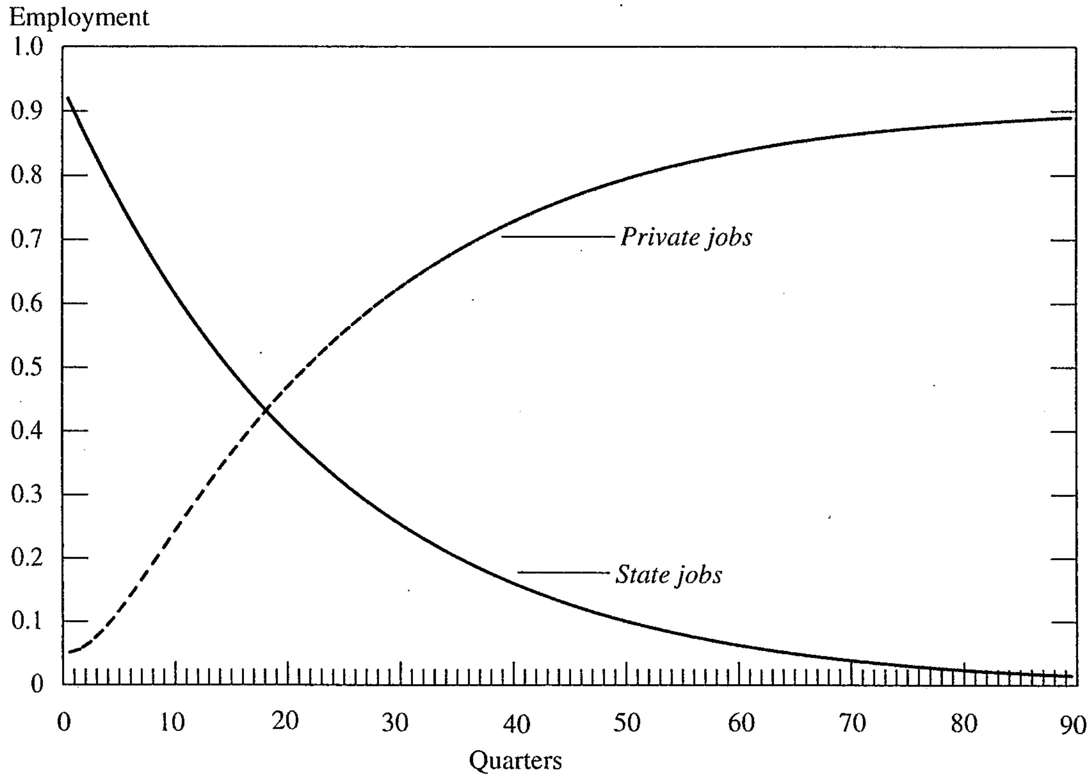
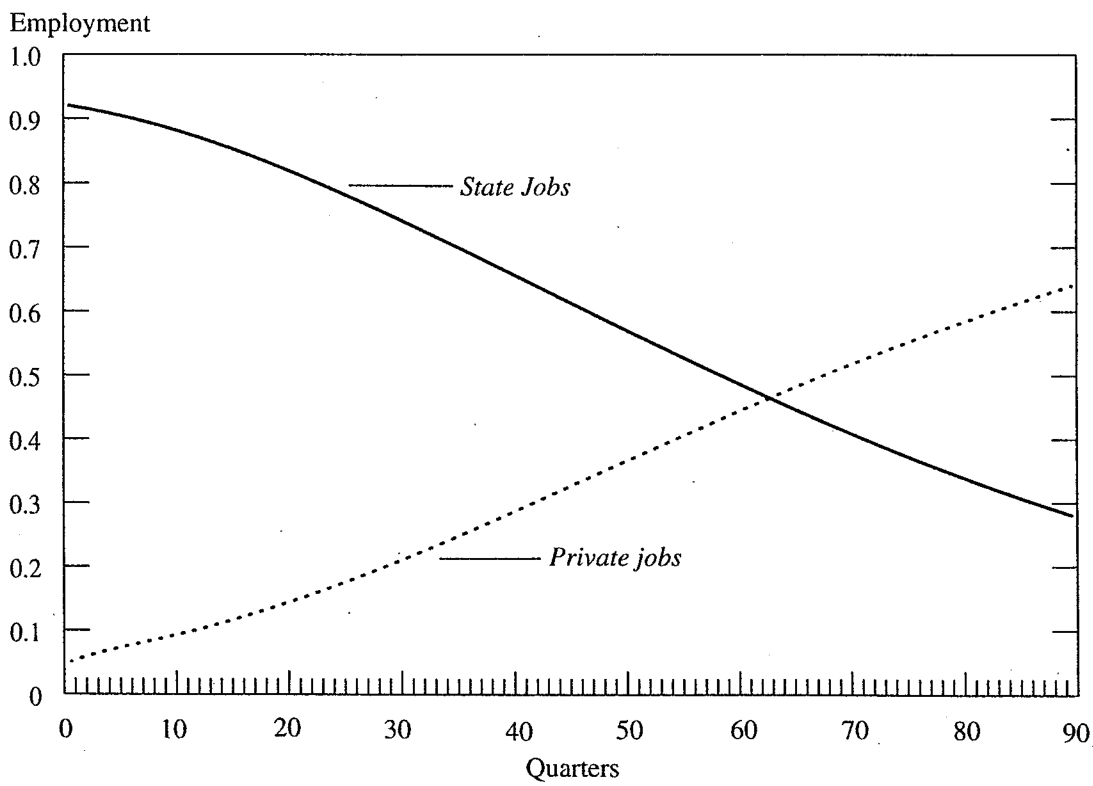


Figure 4. *Private and State Sector Jobs with Low Benefits*



ment effects at the early stage of the transition are quantitatively important. Figure 2 tracks the behavior of real wages and shows that the higher the level of benefits, the lower is the fall in real wages associated with the adverse productivity shocks that hit state sector jobs. With high benefits, jobs with very low productivity are destroyed and the average wage remains relatively high.

Overall, the simulations provided are consistent with the empirical evidence provided in Section II. Higher unemployment benefits increase unemployment at the early stage of the transition, and reduce the fall in real wages. Our model also suggests that countries with high benefits should also have a larger share of private sector employment, but Section II has shown that the evidence on private sector employment is mixed overall.

Minimum Wages

As in most equilibrium models of the labor market, the effect of the minimum wage depends on its level. In our minimalist model, a viable minimum wage must be lower than the unique labor productivity in the private sector; otherwise, the transition cannot even take place. In what follows we assume that the minimum wage in the private sector is not binding, that is, the wage in the private sector w^p is larger than the minimum wage $\bar{w}$, $w^p > \bar{w}$. Since, over time, wages in the public sector fall, it is reasonable to work with the assumption that the minimum wage is binding for some jobs in the state sector.

For those jobs for which the minimum wage is not binding, the surplus is continuously split in fixed proportion. A binding minimum wage in the state sector produces a distributional effect and a destruction effect. For a given surplus from the job, a binding minimum wage increases the share of surplus that goes to the worker, while simultaneously reducing the share that goes to the firm. This is the distributional effect. However, if the total surplus from the job is not sufficient to guarantee the worker the legislated minimum wage, the firm always has the option of immediately destroying the job. This is the destruction effect. Once the share of the residual surplus that goes to the firm becomes negative, the minimum wage induces employer-initiated job destruction.

Appendix IV shows formally that the destruction effect can cause an increase in the reservation productivity. Formally, the reservation productivity induced by the minimum wage satisfies two conditions. First, the productivity level j must be larger than the minimum wage (i.e., $y^j > \bar{w}$). Second, the productivity j minimizes the difference between the productivity level and the minimum wage. With respect to job destruction, an increase in the reservation productivity speeds up job destruction in the state sector and increases the number of people available for work. With respect to job creation, there is only one effect at work, since the vacancy-unemployment ratio is independent of the minimum wage. Since unemployment increases, a binding minimum wage increases job creation and speeds up the transition of employment in the private sector.

Figures 5–8 plot labor market dynamics for two economies, one with a binding minimum wage and the other without a minimum wage. It is clear from Figures 5 and 6 that the higher the minimum wage, the higher the increase in unemployment at early stages of the transition, and the lower the fall in real wages. Figures 7 and 8 show that the relatively high minimum wage increases job destruction in the state sector and speeds up the convergence to the steady state. With respect to the parameter chosen, the minimum wage in Table 7 is extremely high, especially if compared with the wage in the private sector. However, if wages in the private sector were allowed to grow, as they should be in reality, the minimum wage would turn out to be high only at the early stage of the transition. Overall, the simulations are broadly consistent with the cross-country correlation between labor market dynamics and minimum wage. Countries with large minimum wages experience larger increases in unemployment and lower falls in real wages.

Figure 5. *Transition of Unemployment for Different Minimum Wages*

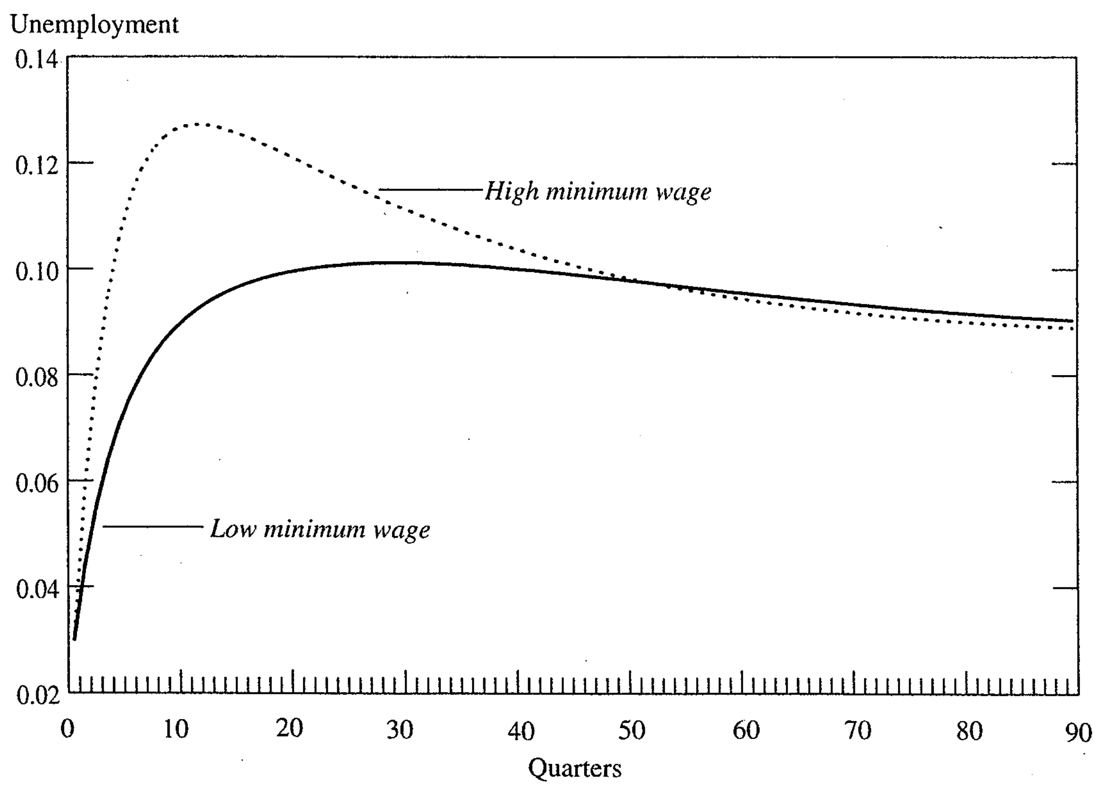


Figure 6. *Transition of Real Wages for Different Minimum Wages*

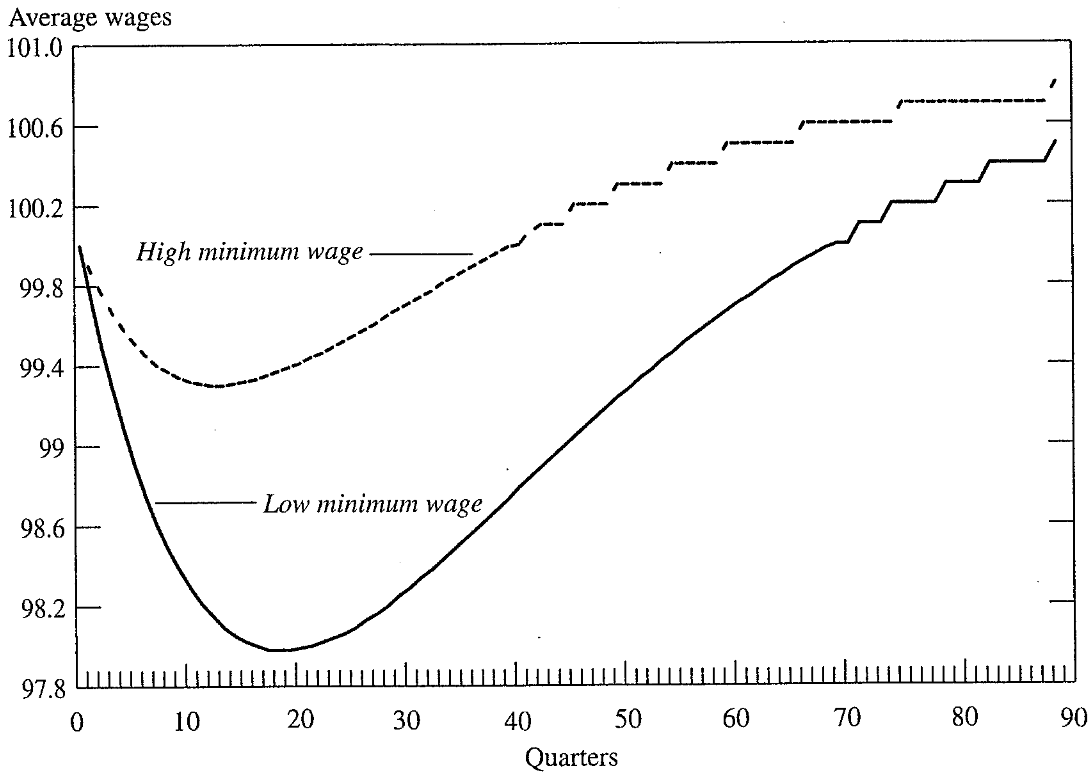


Figure 7. *Private and State Sector Jobs With No Minimum Wage*

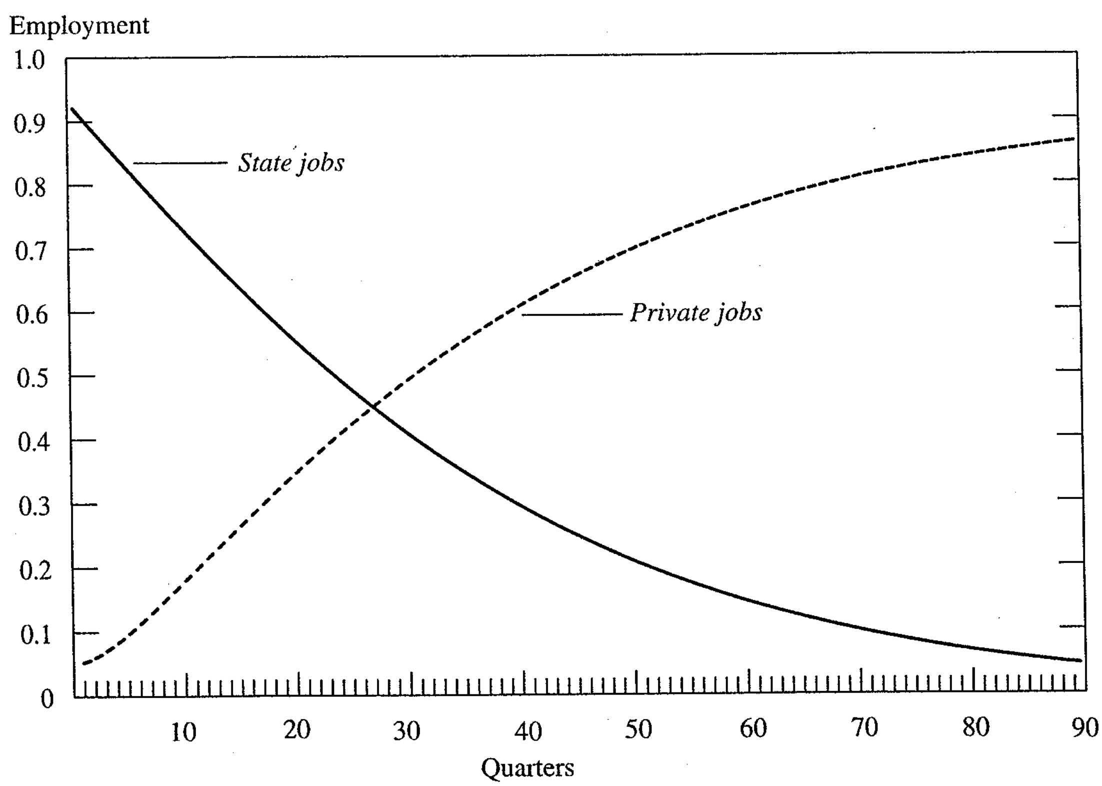
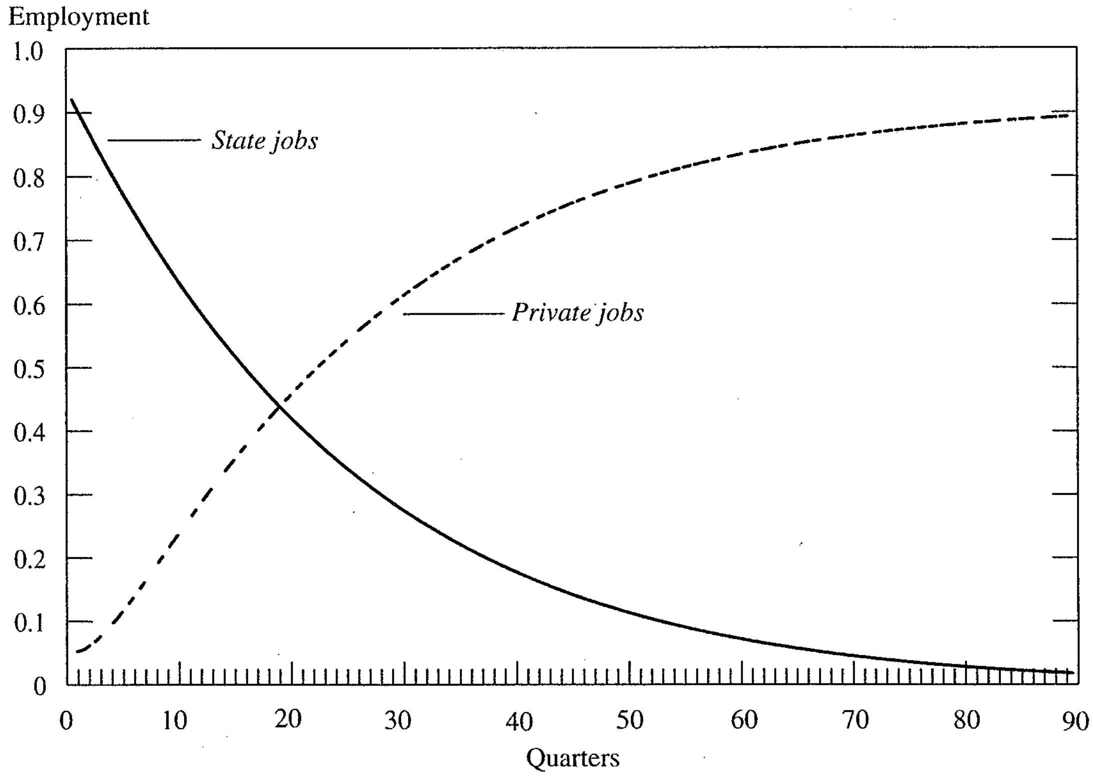


Figure 8. *Private and State Sector Jobs With High Minimum Wage*



VI. Discussion

The results of Section V suggest that there are important links between labor market institutions and the speed of transition. The analysis has shown that cross-country evidence on labor market dynamics is consistent with cross-country differences in labor market institutions, but it has not given any clear policy conclusions. This section discusses some of the main assumptions of the model, and then presents a preliminary discussion on the role that policy may play in the model, even though an in-depth analysis of the optimal level of labor market institutions would require a whole new paper.

Our view on the transition process is entirely focused on the process of job reallocation between the private and the state sector. Even though we think that our approach can shed some light on labor market dynamics and on the speed of job destruction in the state sector, we are aware that our approach neglects important elements of the process. First, we do not consider the role of privatization. While in reality state sector jobs can become private without being destroyed, in our model state sector jobs face only job destruction, and the remaining choice variable is the exact timing of the event.[19] Second, we neglect restructuring in the state sector. In reality, state sector jobs have the option of being restructured and increasing their productivity. We could incorporate restructuring by extending the model in a way similar to Aghion and Blanchard (1994). Finally, we rule out on-the-job search. In reality, there is substantial evidence of job-to-job movement in many transition economies (e.g., Boeri, 1995). To actually keep track of these movements would change the analysis along two dimensions. First, the relevant pool of workers actively engaged in searching activity would increase, and so would private job creation. Second, the possibility that state sector workers find private sector jobs without incurring unemployment would speed up state sector closure. Since both effects would work in the same direction, the speed of transition would increase. However, keeping track of the direct movements from the state sector to the private sector would not change the qualitative results of Section V and would simply make the model analytically tedious.

The discussion on unemployment benefits has not dealt with the issues of benefit financing. In reality, benefits are often linked to payroll taxes levied on employment, and in what follows we consider two cases, depending on whether taxes are levied on the public or the private sector. Let us first assume that payroll taxes are levied only on the private sector, and let us assume that both employers and employees contribute to the payroll tax at rate π (see Appendix IV). Payroll taxes reduce the surplus from the job in the private sector, and they reduce market tightness, so that $(\partial\theta/\partial\pi) \leq 0$, where π is the tax rate. Consequently, equilibrium unemployment rises. With respect to job destruction in the state sector, Appendix IV shows that higher payroll taxes in the private sector increase the surplus from the job in the state sector, that is, $(\partial W^s_{i*})/(\partial\pi) \geq 0$. Higher taxes in the private sector reduce the opportunity cost of working in the state sector and increase the incentive to hold on to low-productivity jobs in the state sector. Thus, higher taxes on the private sector reduce the reservation productivity and tend to offset the relationship between benefits and job destruction. The overall effect of payroll taxes on the private sector can be summarized as follows. On the one hand, higher taxes in the private sector increase steady-state unemployment, exactly as do higher benefits. On the other hand, they increase the surplus in state sector jobs and reduce the impact of higher unemployment benefits on job destruction in the state sector. Let us now assume that payroll taxes are levied on the state sector. In this case, the unemployment in the long run and the surplus in the private sector would be unaffected, while the surplus in the state sector would fall. Thus, payroll

[19]Empirically, there is evidence of substantial growth in private sector employment in transition economies, but it is very difficult to assess to what extent the process is driven by job formation in the emergent private sector or by privatization of the state sector.

taxes on the state sector increase the reservation productivity in the state sector, and speed up job destruction in the state sector.

To put the economy on the optimal transition path, a social planner that chooses the optimal level of benefits would have to balance two forces.[20] By speeding up the destruction of the state sector, a high level of benefits would reduce output at the early stages of the transition. At the same time, it would increase output in the private sector by increasing the rate at which private jobs are formed.

The result that the minimum wage speeds up the reallocation of jobs without affecting the long-run equilibrium of the model rests on the assumption that the minimum wage is not binding in the private sector, and hence does not affect private job creation. In reality, it is probably true that long-run productivity in the private sector is bound to grow substantially, and a high minimum wage at the beginning of the transition is likely to be irrelevant for the long-run equilibrium of the system. However, at the early stages of the transition, heterogeneity in the private sector is likely to be important, and it is possible that some jobs in the private sector have productivity below the minimum wage. If that is the case, a high minimum wage would reduce job creation in the private sector, and the overall relationship between the minimum wage and the speed of transition would depend on two effects. First, the unemployment effect induced by job destruction in the private sector would increase job creation. Second, the minimum wage would reduce the job-finding rate. In this respect, the minimum wage would work like the level of benefits in Section V. Neglecting heterogeneity in the private sector, a social planner that chooses a minimum wage to maximize output would need to balance two effects: a high minimum wage would reduce output at the early stage of the transition, but it would increase output in the private sector by increasing the flow of job formation in the private sector.

VII. Conclusions

This paper has examined the interactions between labor market institutions and the dynamics of unemployment and real wages in transition economies. In a dynamic matching model in which the state sector endogenously sheds labor and private job creation takes time, the paper has shown that labor mar-

[20]Typically, the optimal transition path maximizes the discounted lifetime utility of the representative agent. Since in our model the representative agent's utility function is linear in consumption (i.e., the agent has risk-neutral preferences), maximizing the lifetime utility is equivalent to maximizing the present discounted value of the aggregate output.

ket institutions, such as the unemployment insurance system and the minimum wage, are important determinants of labor market dynamics.

We have briefly reviewed the labor market experience of several CEE economies and two CIS economies, Russia and Ukraine, and we have argued that the differences in labor market dynamics should be analyzed together with differences in labor market institutions. CEE economies, with the exception of the Czech Republic, have experienced a dramatic rise in unemployment and substantial fall in real wages. Conversely, CIS countries have experienced a moderate increase in unemployment and a substantial decline in real wages. Not surprisingly, differences in labor market institutions are also remarkable. The minimum wage is much higher in CEE economies than in Russia and Ukraine, and the unemployment insurance system is much more generous.

The paper has proposed and solved a matching model of job reallocation between the public and the private sector, and has shown that cross-country differences in labor market institutions are broadly consistent with cross-country differences in the dynamics of unemployment and real wages. Two main results arose from the analysis. First, higher unemployment benefits speed up job destruction in the state sector and job creation in the private sector at the early stages of the transition, but they increase unemployment in the steady state. Second, a higher minimum wage can theoretically speed up the reallocation process without affecting the long-run equilibrium. These results have shown that the steady-state effects of labor market institutions are very different from the transition effects, and only with a dynamics analysis is it possible to distinguish between the temporary and permanents effects.

From an economic policy standpoint, the paper has shown that during the transition, institutions that make unemployment more attractive can speed up the process of job reallocation between low-productivity jobs in the public sector and high-productivity jobs in the emerging private sector. Other traditional instruments, like cuts in subsidies to low-productivity jobs in the public sector, have not been formally analyzed, and an extension of the model would show that subsidy cuts speed up the reallocation process. Furthermore, such policies would not affect the steady-state equilibrium of the system.

APPENDIX I

Surplus in the Private Sector and the Equilibrium Transition Path of θ

This Appendix derives the surplus in the private sector and solves for the equilibrium transition path of θ. Let E^p and U be the values for the worker of being employed in the private sector and being unemployed, respectively. The Bellman equations can be written as

$$rE^p = w^p + \lambda\left(U - E^p\right) + \dot{E}^p \tag{A1}$$

$$rU = b + \theta q(\theta)\left(E^p - U\right) + \dot{U}. \tag{A2}$$

Equation (A1) implies that the return to the worker from working in the private sector equals his wages plus the expected loss from becoming unemployed and the change in the value of working over time. Similarly, equation (A2) implies that the return to a worker from being unemployed equals the unemployment benefit plus the expected gain from finding a job and the change in the value of being unemployed over time. From equations (A1) and (A2) it follows that an unemployed worker is willing to take on a job as long as $E^p \geq U$.

Similarly, let J^p and V^p be the values for the private firm of a filled job and a vacant job, respectively. The Bellman equations for these values are

$$rJ^p = y^p - w^p + \lambda\left(V^p - J^p\right) + \dot{J}^p \tag{A3}$$

and

$$rV^p = -\gamma + q(\theta)\left(J^p - V^p\right) + \dot{V}^p. \tag{A4}$$

Equation (A3) implies that the return to the firm from a filled job equals the profit minus the expected loss from job destruction plus the change in the value of the filled job over time. Equation (A4) implies that the return on a vacant job equals the expected return from filling a job net of cost, plus the change in the value of the vacant job over time. Since, in equilibrium, $V^p = \dot{V}^p = 0$, equation (A4) yields

$$J^p = \frac{\gamma}{q(\theta)}. \tag{A5}$$

The surplus associated with the job is

$$W^p = J^p + E^p - U. \tag{A6}$$

Using the splitting rule $E^p - U = \beta W^p$ and $J^p = (1-\beta)\, W^p$, the free-entry condition $V^p = \dot{V}^p = 0$ and substituting equations (A1) – (A3) into equation (A6), the surplus in private jobs becomes

$$(r + \lambda)W^p = \left[y^p - b - \theta q(\theta)\beta W^p\right] + \dot{W}^p. \tag{A7}$$

Again, using the splitting rule and substituting equation (A5) into (A7), we get the following differential equation in θ:

$$\frac{(r+\lambda)\gamma}{(1-\beta)q(\theta)} = y^p - b - \frac{\gamma q'(\theta)}{q(\theta)^2}\dot{\theta} - \frac{\beta\gamma\theta}{1-\beta}. \tag{A8}$$

In the steady-state equilibrium, $\dot{\theta} = 0$. It is straightforward to see that there exists a unique steady-state equilibrium satisfying these two conditions and that the equilibrium transition path of θ leading to this steady state is also unique. Furthermore, θ is constant along this transition path.

APPENDIX II

Aggregate Dynamics

Unemployment dynamics is given by the difference between aggregate job creation and aggregate job destruction. Job creation comes from the matching of unemployed workers and vacant jobs. Job destruction comes from those jobs that are hit by the shock λ, plus the state-owned jobs whose productivity falls below the reservation productivity i^*. For a given reservation productivity i^*, the unemployment transition path evolves according to

$$\dot{u} = JD - JC, \tag{A9}$$

where

$$JD = \lambda\left(1 - u - n^s\right) + \delta\left(\sum_{k=i^*}^{n} \frac{i^* - 1}{k} n_k^s\right)$$

is the overall job destruction and

$$JC = \theta q(\theta) u$$

is the private sector job creation. The initial condition is $u_0 = 0$. Summation in the job destruction term refers to the fraction of state sector jobs with a productivity index higher than i^* that draw a productivity index lower than i^*. To solve for unemployment in equation (A9), we need to specify the dynamics of the state sector jobs at different productivity indices. From the definition of productivity index i^* in equation (14), it follows that

$$\dot{n}_i^s = -\lambda n_i^s - \delta\left(\frac{i-1}{i}\right) n_i^s + \delta\left(\sum_{k=i}^{n} \frac{1}{k} n_k^s\right) \quad \text{if } i \geq i^* \tag{A10}$$
$$n_i^s = 0 \quad \text{if } i < i^*,$$

where the initial condition is $\sum_{i=1}^{n} n_{i,0}^s = 1$. The first term in the first equation refers to immediate job destruction from state i, the second term keeps track of outflows to other states, and the last term keeps track of inflows into state i from other public sector jobs with productivity state above i. Finally, private sector employment is the residual difference between the fixed labor force, unemployment, and state sector employment, and reads

$$n^p = 1 - u - \sum_{i=1}^{n} n_i^s. \tag{A11}$$

APPENDIX III

Transition Path of Wages

This Appendix shows how to derive the wage in the private sector and the average wage that is used in the simulation of Section V. Since θ is constant along the equilibrium transition path, the surplus in the private sector job, W^p, can be written as

$$(r+\lambda)W^p = \frac{(1-\beta)(y^p - b) - \theta\beta\gamma}{1-\beta} \tag{A12}$$

and the wage associated with this surplus reads

$$w^p = y^p - (r+\lambda)(1-\beta)W^p. \tag{A13}$$

To obtain the surpluses W_i^s and wages $w_i^s (i=1, \ldots n)$ in the state sector we start with the least productive job ($i=1$) and we proceed recursively. From equations (13) and (14), the surplus and the wage in the least productive state sector job read

$$W_1^s = \frac{y_1^s - b - \theta q(\theta) W^p}{r+\lambda} \tag{A14}$$

and

$$w_1^s = y_1^s - (r+\lambda)(1-\beta)W_1^s. \tag{A15}$$

Similarly, the surplus and the wage in the second least productive job read

$$W_2^s = \frac{y_2^s - b - \delta\frac{1}{2}\max\left[W_1^s, 0\right]}{r+\lambda+\delta/2} \tag{A16}$$

and

$$w_2^s = y_2^s - \left(r+\lambda+\frac{\delta}{2}\right)(1-\beta)W_2^s + \frac{\delta}{2}\max\left[(1-\beta)W_1^s, 0\right]. \tag{A17}$$

The remaining surpluses and wages can be determined in a similar way. The reservation productivity level, i^*, is the index of the first positive surplus. The dynamics of the average wage are completely driven by changes in employment across sectors and across productivity states in the public sector. At every point in time, the average wage reads

$$w_a = \frac{\sum_{i=1}^{n} w_i^s n_i^s + w^p n^p}{1-u}, \tag{A18}$$

where

$$\sum_{i=1}^{n} w_i^s n_i^s + w^p n^p$$

is the total wage bill and $1 - u$ is total employment.

APPENDIX IV

Labor Market Institutions

Unemployment Benefits

Proposition: $\partial W_i^s / \partial b \leq 0$. The surplus associated with a job of productivity i is decreasing in unemployment benefits.

Proof: We proceed in three steps. First we show that the ratio of vacancies to unemployed, θ, is decreasing in unemployment benefits, b. Then we show that the surplus associated with a private sector job, W^p, is decreasing in b. Finally we show that surpluses in state sector jobs are decreasing in b.

Step 1. To show that $\frac{\partial \theta}{\partial b} < 0$ we differentiate the steady-state version of equation (A8) (i.e., setting $\theta = 0$) with respect to b and we obtain

$$\frac{\partial \theta}{\partial b}\left(\frac{\beta\gamma}{1-\beta} - \frac{(r+\lambda)\gamma \frac{\partial q(\theta)}{\partial \theta}}{(1-\beta)q(\theta)^2} \right) = -1. \tag{A19}$$

Since, by assumption $\frac{\partial q(\theta)}{\partial \theta} < 0$, equation (A19) implies that $\frac{\partial \theta}{\partial b} < 0$.

Step 2. From equations (A5) and (A7) we obtain

$$(r+\lambda)\frac{\partial W^p}{\partial b} = \frac{(r+\lambda)\gamma \frac{\partial q(\theta)}{\partial \theta}}{\beta\gamma q(\theta)^2 - (r+\lambda)\gamma \frac{\partial q(\theta)}{\partial \theta}} < 0 \tag{A20}$$

Step 3. From equation (13), the surplus in the least productive state job is

$$(r+\lambda)W_1^s = y_1^s - b - \frac{\theta\beta\gamma}{1-\beta}. \tag{A21}$$

It is clear that $sign\left(\frac{\partial W_1^s}{\partial b}\right)$ is identical to $sign\left(\frac{\partial W^p}{\partial b}\right)$. Given these results, the surplus of the second least productive state sector job satisfies

$$(r+\lambda+\delta/2)W_2^s = y_2^s - b\frac{\theta\beta\gamma}{1-\beta} + \delta\frac{1}{2}\max\left[W_1^s, 0\right] \tag{A22}$$

and must be also decreasing in b.

Minimum Wage

We now consider the case of minimum wage binding for (some) state sector jobs. Let us suppose that a minimum wage, $w_{\min}=\overline{w}$ is introduced, and let us assume that $w_j^s < \overline{w}$, where w_j^s is the wage obtained with the sharing rule applied in the text. The minimum wage can produce two effects. The first effect is a *distributional effect*. More specifically, denoting the return to the worker from being employed in a state sector job with productivity j, ($E_{j(\min)}^s$), the share that goes to the worker must necessarily be greater than the share obtained with the splitting rule, thus $E_{j(\min)}^s - U > \beta W_j^s$.[21] Conversely, the share that goes to the firm must necessarily be lower than $(1-\beta)$. Since the outside option for a firm is zero, a firm is willing to form a match as long as its share of the total surplus is positive, that is, $J_{j(\min)}^s > 0$,where $J_{j(\min)}^s$ denotes the firm value of having a job of productivity j that pays the minimum wage. While, at least in principle, a worker is always willing to form a match with a binding minimum wage, the problem faced by a state sector firm reads

$$\begin{aligned} rJ_{j(\min)}^s &= y_j^s - \overline{w} - \lambda J_{j(\min)}^s + \delta\sum_{k=1}^{j-1} \max_{\phi_k=0,1}\left[(1-\phi_k)(0-J_{j(\min)}^s)\right] + \dot{J}_{j(\min)}^s \\ \phi_k &= 1 \quad \text{if } J_{k(\min)}^s > 0 \\ &= 0 \quad \text{otherwise,} \end{aligned} \tag{A23}$$

where the operator function ϕ keeps track of the decision to keep open a job paying a minimum wage as long as the residual fraction of the surplus that goes to the firm is positive. Equation (A23) highlights the second effect of the minimum wage, that is, the *destruction effect*. In principle, a minimum wage can increase the value of the reservation productivity index and cause faster destruction of low-productivity jobs. Since firms are obliged to pay workers the minimum wage $\overline{w}$, the fall in the present value of future

[21]Since, by assumption, the minimum wage is not binding in the private sector, the value of being unemployed, U, does not change and is described by equation (A2).

profits may be so high that the value of the job turns negative, and it becomes optimal to immediately shut down the job.

Similarly to equation (A23), the return to the worker employed in a firm that pays a binding minimum wage is

$$rE^s_{j(\min)} = \overline{w} + \lambda\left(U - E^s_{j(\min)}\right) + \delta\sum_{k=1}^{j-1}\frac{1}{j}\max_{\phi_k=0,1}\left[(1-\phi_k)(U - E^s_{j(\min)})\right] + \dot{E}^s_{j(\min)}$$

$$\begin{aligned}\phi_k &= 1 \text{ if } J^s_{k(\min)} > 0\\ &= 0 \text{ otherwise,}\end{aligned} \qquad \text{(A24)}$$

where $\overline{w}$ is the minimum wage, $\lambda(U-E^s_{j(\min)})$ is depreciation due to the destructive shock, the term in brackets is the capital loss associated with changes in the productivity index, and the last term is the capital gain.

To summarize, equations (A23) and (A24) show that for a given reservation productivity i^*, the introduction of the minimum wage implies the selection of a new reservation index, $i_{\overline{w}}$, determined in the following way:

$$\begin{aligned} &i_{\overline{w}} = i^* && \text{if} \quad w^s_{i^*} \geq \overline{w} \\ &i_{\overline{w}} = j;\ j \geq i^* && \text{if} \quad w^s_{i^*} < \overline{w} \\ &\left(\text{where } j \text{ is } s.t.\ \ y^s_j > \overline{w} \geq y^s_{j-1}\right) \end{aligned} \qquad \text{(A25)}$$

The first row in equation (A25) says that the reservation productivity does not change if the minimum wage is not binding and is below the negotiated wage. The second row says that when the minimum wage is binding the reservation productivity may increase. The last row says that the new reservation productivity is the first productivity index higher than the minimum wage. The derivation of the reservation productivity is as follows:

Claim: If the minimum wage $w_{\min} = \overline{w}$ is binding for jobs with productivity $j \geq i^* \geq 1$ the match j is terminated if and only if $y^s_j \leq \overline{w}$.

Proof: First suppose that the minimum wage is not used. We know from equation (15) that with $i^* \geq 1$, the surplus associated with this job is

$$\left(r + \lambda + \delta\frac{i^* - 1}{i^*}\right)W^s_{i^*} = y^s_{i^*} - b - \theta q(\theta)\beta W^p, \qquad \text{(A26)}$$

which can be decomposed into a surplus to a worker:

$$\left(r + \lambda + \delta\frac{i^* - 1}{i^*}\right)\left(E^s_{i^*} - U\right) = w^s_{i^*} - b - \theta q(\theta)\beta W^p, \qquad \text{(A27)}$$

and a surplus to a firm:

$$\left(r+\lambda+\delta\frac{i^{*}-1}{i^{*}}\right)J_{i*}^{s}=y_{i*}^{s}-w_{i*}^{s} \tag{A28}$$

Now suppose that the minimum wage $\overline{w} \geq w_{i*}^{s}$ is imposed. From equation (A28) we see that $\overline{w} \geq y_{i*}^{s}$ iff $J_{i*}^{s} \leq 0$, that is, we have proved our claim for i^{*}. Since if minimum wage is higher than labor output at job $j, j > i^{*}$, it is also higher than labor output at job k, $i^{*} \leq k < j$, the claim holds for any $j \geq i^{*}$.

APPENDIX V

Payroll Taxes

The Case of Taxes Levied on the Private Sector

If both the employer and the employee contribute to a payroll tax at rate π, the gross wage for the employer is $w(1+\pi)$ and the net wage for the employee is $w(1-\pi)$. The total surplus reads

$$(r+\lambda)W^{p}=y^{p}-2\pi w^{p}-\beta\theta q(\theta)W^{p}, \tag{A29}$$

where w^{p} can be obtained from the firm's value function and reads

$$w^{p}=\frac{y-(r+\lambda)(1-\beta)W^{p}}{1+\pi}. \tag{A30}$$

Combining equations (A29) and (A30), and making use of the free-entry condition (A5), θ is uniquely determined by

$$\frac{(r+\lambda)\gamma}{(1-\beta)q(\theta)}=\frac{(1-\pi)y}{1+\pi}+\frac{2\pi(r+\lambda)}{1+\pi}\frac{\gamma}{q(\theta)}-\frac{\beta\theta\gamma}{1-\beta} \tag{A31}$$

We derive two comparative static results. First, $(\partial\theta)/(\partial\pi) < 0$. Differentiating equation (A31) with respect to θ, and rearranging yields

$$\frac{-\gamma q'(\theta)(r+\lambda)[1-\pi+2\beta\pi(2-\beta)]+\beta\gamma(1-\beta)q(\theta^{2})(1+\pi)}{(1-\beta)^{2}q(\theta)^{2}(1+\pi)}\frac{\partial\theta}{\partial\pi}=$$

$$\frac{-2(r+\lambda)\gamma}{q(\theta)(1+\pi)^{2}}-\frac{2\pi y^{p}}{(1+\pi)^{2}}$$

Since the right-hand side is negative and the fraction on the left-hand side is positive, the results immediately follow. Second, $(\partial W_{i*}^{s})/(\partial\pi)>0$. Differentiating W_{i*}^{s} with respect to π yields

$$\left(r+\lambda+\delta\frac{i^*-1}{i^*}\right)\frac{\partial W^s_{i^*}}{\partial\pi}=-\beta\gamma\frac{\partial\theta}{\partial\pi}. \tag{A32}$$

Making use of the fact that $(\partial\theta)/(\partial\pi) < 0$, the results follow immediately.

If only public sector employee and employer contribute at rate π at a payroll tax, steady state market tightness θ is not affected. Proceeding as in equations (A30) and (A31), the surplus from a state sector jobs with payroll taxes reads

$$\frac{\left(r+\lambda+\delta\left(i^*-1\right)/i^*\right)\left(1+\pi+2\pi\beta\right)}{1+\pi}W^s_{i^*}=y^s_{i^*}-b-\beta\theta q(\theta)w^p-\frac{2\pi y}{1+.} \tag{A33}$$

$(\partial W^s_{i^*})/(\partial\pi) < 0$. Differentiating equation (A33) with respect to π and rearranging yields

$$\frac{\partial W^s_{i^*}}{\partial\pi}\left(r+\lambda+\delta\left(i^*-1\right)/i^*\right)\left(1+\pi+2\pi\beta\right)=\frac{-2y\beta}{(1+\pi)^2}-\frac{\left(b+\theta q(\theta)W^p\right)2(1-\beta)(1+\pi)}{(1+\pi)^2}$$

The results follow immediately.

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